

*Research Paper* ■

# Organizational and Physician Perspectives about Facilitating Handheld Computer Use in Clinical Practice: Results of a Cross-Site Qualitative Study

ANN SCHECK McALEARNEY, ScD, MS, SHARON B. SCHWEIKHART, PhD,  
MITCHELL A. MEDOW, MD, PhD

**Abstract** **Objective:** To describe strategies that organizations select to support physicians' use of handheld computers (HHCs) in clinical practice and to explore issues about facilitating HHC use.

**Design:** A multidisciplinary team used focus groups and interviews with clinical, administrative, and information technology (IT) staff to gather data from 161 informants at seven sites. Transcripts were coded using a combination of deductive and inductive approaches to both answer research questions and identify patterns and themes that emerged in the data.

**Measurements:** Answers to questions about strategies for HHC support and themes about (1) how to facilitate physician adoption and use and (2) organizational concerns.

**Results:** Three main organizational strategies for HHC support were characterized among sites: (1) active support for broad-based use, (2) active support for niche use, and (3) basic support for individual physician users. Three high-level themes emerged around how to best facilitate physician adoption and use of HHCs: (1) improving usability and usefulness, (2) promoting HHCs and device use, and (3) providing training and support. However, four major themes also emerged related to organizations' concerns about HHC use: (1) security-related concerns, (2) economic concerns, (3) technical concerns, and (4) strategic concerns.

**Conclusion:** An organizational approach to HHC support that involves individualized attention to existing and potential physician users rather than one-size-fits-all, organization-wide implementation efforts was an important facilitator promoting physician use of HHCs. Health care organizations interested in supporting HHC use must consider issues related to security, economics, and IT strategy that may not be prominent concerns for physician users.

■ *J Am Med Inform Assoc.* 2005;12:568–575. DOI 10.1197/jamia.M1816.

This paper describes organizational strategies and facilitators to support physicians' use of handheld computers (HHCs) in clinical practice and explores concerns about HHC use.

Affiliations of the authors: Division of Health Services Management and Policy, School of Public Health, The Ohio State University (ASM, SBS); Departments of Pediatrics (ASM) and General Internal Medicine (MAM), College of Medicine and Public Health, The Ohio State University, Columbus, OH.

The authors are extremely grateful to the Center for Health Management Research for funding this research and to the organizations and informants who participated in this study. They also thank research associates Tracy Bryan and Sarah Hoshaw for their work with transcribing, data analysis, and literature reviews.

Preliminary findings from this research were peer reviewed and presented at the 2004 AcademyHealth Annual Research Meeting, San Diego, CA (June), the 2004 Academy of Management Annual Research Meeting, New Orleans, LA (August), and the 2004 INFORMS Conference, Denver, CO (October).

Correspondence and reprints: Ann Scheck McAlearney, ScD, MS, Division of Health Services Management and Policy, The Ohio State University, 1583 Perry Street, Atwell 246, Columbus, OH 43210-1234; e-mail: <mcalearney.1@osu.edu>.

Received for review: 02/24/05; accepted for publication: 05/12/05.

## Background

Physicians use HHCs for a variety of purposes including administrative functions, clinical and reference database access, research activities, and medical education.<sup>1–3</sup> In clinical practice, HHCs can help physicians enhance care and service to patients and improve productivity by streamlining administrative tasks such as charge capture or transmitting prescriptions.<sup>1,2,4–9</sup> Surveys estimate that around half of U.S. physicians currently use HHCs,<sup>10,11</sup> but usage levels widely vary.<sup>2</sup>

What is the appropriate role of the health care organization in supporting growing HHC use among physicians? Handheld computers are different from many other health care information technology (IT) solutions for a number of reasons including their usability, flexibility, customizability, portability, and low initial financial investment. Moreover, whereas most clinical IT use is driven by the decisions of top administrators and clinical staff, HHC use is typically driven by practicing physicians, many of whom purchase their own devices. This bottom-up and often diffuse adoption process thus involves a fundamentally different role for organizational IT management.

Existing literature describes physicians' HHC use and enumerates barriers to expanding adoption.<sup>1,6,12–14</sup> However,

no research has examined the question of how organizations can appropriately support physician use of HHCs. We considered this question from the perspectives of both organizations and physicians, as part of a cross-site qualitative study of HHC use by physicians. We sought answers to questions about how and why organizations do and could facilitate physicians' HHC use.

## Research Question and Research Objective

Our research question was "How do organizations support physicians' use of HHCs in clinical practice?" Our research objective was to develop an evidence-based understanding of the chief strategies, facilitators, and concerns associated with organizational support of physicians' HHC use in clinical practice, as we present in this paper.

## Methods

### Study Design

We conducted seven organizational case studies<sup>15</sup> and eight focus groups<sup>16</sup> between April 2002 and September 2003 and investigated both organizational and physician perspectives about HHC use in clinical practice. We used a standard, semi-structured guide in both interviews and focus groups that included open-ended questions to promote discussion.<sup>17</sup>

Our extensive qualitative design<sup>18</sup> enabled us to answer our research question and to explore the different issues that emerged around answers to that question. This qualitative approach was appropriate because of the exploratory approach to our research question, as well as our suspicion that organizations' support decisions might be multidimensional and thus difficult to examine with quantitative techniques.<sup>17</sup> Further, our selection of qualitative methods enabled us to explore support issues and provided rich information about the multiple facets of organizations' support decisions and concerns.<sup>17,19</sup>

### Organizational Case Studies

Organizations were purposely selected based on their experience with HHCs, consistent with rigorous qualitative research standards.<sup>19,20</sup> We avoided early adopters to obtain perspectives about organizational challenges and facilitators that might be applicable to a broad range of health care organizations. We selected seven organizations with varying geographic locations (two west coast, three midwest, and two eastern sites) and organizational types (two academic medical centers, one large independent practice association, two community-based health care systems, and two community-based hospitals).

Case studies consisted of multiple in-depth interviews<sup>21</sup> with organizational and physician informants. There were a total of 67 key informants. Among organizational informants ( $n = 47$ ), 17 were physicians who held organizational positions. Organizational informants included individuals with titles such as Chief Information Officer, Chief Operations Officer, Medical Director, and Information Systems Director. Interviews with organizational informants lasted 60 to 120 minutes. Physician informants ( $n = 20$ ) included both medical and surgical providers. Physician interviews lasted 15 to 60 minutes.

### Focus Groups

We conducted focus groups at six case study organizations and held two additional focus groups at a regional meeting

of the Society of General Internal Medicine. Focus groups included 54 physicians representing a broad range of specialties and levels of interest in HHCs. Eight of the focus group participants also served as case study informants in one-on-one interviews in which they were asked in-depth questions about HHC use and organizational support. Physicians who participated in focus groups were characterized as power users (13%), routine users (50%), niche users (20%), or nonusers (17%) of HHCs.<sup>2</sup> Focus groups lasted 60 to 90 minutes.

## Measurements and Analyses

Interviews and focus group sessions were audiotaped and professionally transcribed, yielding 76 transcripts and over 800 single-spaced pages for analysis. Our analyses used the constant comparative method of qualitative data analysis,<sup>20</sup> and common techniques for coding data.<sup>16,22</sup> Using a grounded theory approach,<sup>20,23</sup> we read transcripts and discussed findings as the study progressed. This iterative process allowed us to explore new themes that emerged in subsequent interviews and focus groups.

We applied a combination of deductive and inductive methods in our analyses. Prior to coding the data, we deductively produced ideas about themes that we expected to find. Close reading of the transcripts then inductively advanced code development. Our coding process allowed us to organize our data into categories of findings and permitted us to identify patterns and broad themes that emerged from the data.<sup>17</sup> We use the term *pattern* to describe a cohesive category of responses found across informants. We use the term *theme* to identify a broad concept or topic area that aggregates patterns observed in the data. For example, patterns around IT security and data confidentiality emerged from our reading and coding of transcripts. After finding these consistent patterns across informants, we defined the theme of "security-related concerns" to describe the broader concept represented by these comments.

Periodic discussions among the investigators ensured consistency of coding and helped us reach agreement about final themes emerging from the data. Moreover, throughout the study, we continued our review of available literature about HHC use in clinical practice to help us validate, compare, and extend our findings.<sup>20</sup> We used the qualitative data analysis software Atlas.ti (version 4.2)<sup>24</sup> to support our analyses.

## Results

Answers to our main research question by both organizational and physician respondents enabled us to explore several issues around clinical HHC use in depth. First, we characterized three alternative strategies for organizational support of HHC use. Second, we identified three main themes about how organizations can and could facilitate adoption and use of HHCs in clinical practice. Third, we characterized four major themes regarding organizational concerns about HHC use. Each of these themes was seen across sites, supporting the validity of our findings, and quotations have been selected that are representative of the data. Quotations that articulate common points particularly well are presented verbatim.

### Organizational Strategies to Support HHC Use

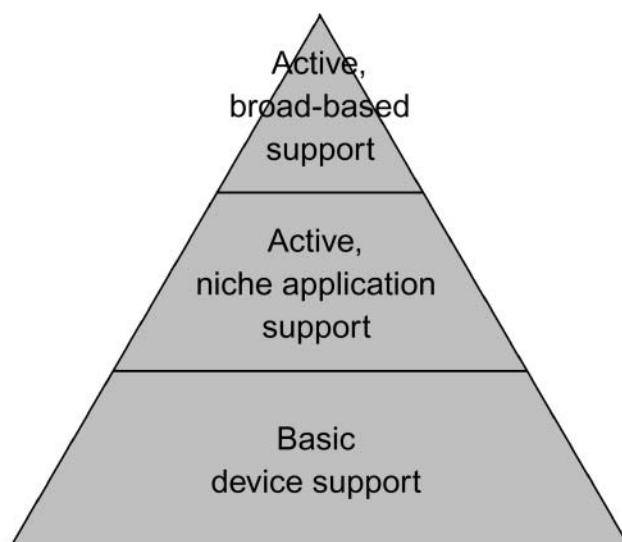
We characterized three organizational strategies to support physicians' HHC use, as observed among our case study

sites: (1) active support for broad-based HHC applications (three sites), (2) active support for HHC niche applications (two sites), and (3) basic support for individual HHC users (two sites). These strategies, as shown in Figure 1, were not mutually exclusive, but instead were hierarchical. Thus, all organizations provided at least basic support for HHC users, but some also actively promoted use. Organizations' broad-based active support included support of niche applications, as well as basic user support.

Decisions about HHC support strategies appeared to be based on each organization's view of the strategic role of HHCs in their evolving IT environment. For instance, the three organizations demonstrating active, broad-based support were attempting to improve physicians' access to information and reported that they viewed HHCs as another tool by which to provide that access. As one organizational representative explained, they try to "provide additional information to make their [physicians'] point of care decision

an informed decision." Another noted that "it is part of the IT strategy. One of the organizational goals is to be a physician's best partner—to improve relations with physicians, make it easier for them to practice medicine—which for us means to provide systems that support the practice of medicine."

In contrast, the two organizations that were reportedly less convinced about the long-term role of HHCs within clinical medicine limited their HHC support to basic IT assistance, seeking neither to promote nor actively facilitate physician use. One informant noted, "chances are they're not going to make a 20 million dollar investment in a new IS system just so you can link it with your Palm." However, basic support was reportedly still important because, as one organizational respondent explained, "people are buying them [HHCs] themselves personally and they are theirs, but they hook them up to our PCs and network and it becomes our problem."



Legend	
Strategy Description	Rationale
<b>Active, broad-based support:</b> Organization invests in infrastructure to facilitate broad-based HHC use, including purchasing consultation, training, software installation, device maintenance, providing infrared printers, and/or providing equipment for syncing to download data.	HHCs are an effective option for making information available at the point of care and will continue to represent a critical access point to the organization's clinical data systems.
<b>Active, niche application support:</b> Organization pursues one or more targeted application projects, examples include hospital charge capture, centralized tracking of patient data, or supporting hand-offs of patient information at resident shift changes.	Niche HHC applications are expected to produce a specific outcome (e.g., cost reduction, regulatory compliance, improved communications). Added benefit may include organizational learning about HHC technology.
<b>Basic device support:</b> Organization provides a basic level of IT support to physicians seeking HHC assistance, but does not actively promote HHC use. Support may include offering guidelines for purchasing, installing software, and/or providing limited syncing equipment.	Need to ensure that all HHC use is appropriate for the organization's technology infrastructure and complies with information security and privacy policies.

**Figure 1.** Organizational strategies for handheld computer support.

The two organizations classified as providing active support for niche applications were reportedly interested in how these applications could support and even improve clinical practice, despite the associated resource requirements of this support strategy. As one informant explained, “by default, we have become troubleshooters of ePocrates [a pharmaceutical reference].” Both organizations reported satisfaction with this support strategy and provided many examples of how physicians appreciated their active niche support.

### Facilitating Physicians’ Adoption and Use of Handheld Computers

Three main themes emerged across informants and organizations about opportunities to facilitate adoption and use among physicians: (1) improving usability and usefulness, (2) promoting HHCs and device use, and (3) providing training and support. Representative comments and associated patterns within each theme are shown in Table 1.

### Facilitation Theme 1: Improving Usability and Usefulness

A key pattern that emerged in our data was the need to make HHCs more useful in physicians’ clinical practice to facilitate adoption. Organizational IT staff spoke of wanting to make HHC use more “intuitive” and “efficient,” even though these performance features are typically controlled by device designers. As one respondent explained, “you’ve got to make it easier for them [physicians] than picking up a pen and piece of paper.”

A second pattern identified in comments across organizations was the potential for HHCs to help physicians in their clinical practices. It was noted that HHCs “provide some information technologies that actually improved the working environment of physicians.” A third related pattern surrounded the potential of HHCs to help reduce medical errors. While none of our study sites was able to demonstrate such effects, they were reportedly confident that HHCs could help, and several

Table 1 ■ Themes: Facilitating Physicians’ Use of Handheld Computers in Clinical Practice

Utterances	Patterns	Themes
“Make it easier for them than picking up a pen and piece of paper” “Listening to our customers, what they say they really need, and then delivering it to them” “What are the things that the current providers who are using it might find attractive?”	Make it useful	Usability and usefulness
“Provide some information technologies that actually improved the working environment of physicians”	Help physicians with their work	
“If a physician doesn’t go back and forth to the unit, ...that is a process improvement” “We think it is going to help improve outcomes” “Reduce prescription errors and illegible handwriting, drug-to-drug interaction”	Potential to reduce medical errors	
“Part of being part of this pilot is you’ll receive a PDA device” “Giving them out early and allowing them to play” “We created what we refer to as a sandbox which is a place physicians can go play without getting hurt”	Pilot projects and encouraging experimentation	Promotion
“A pilot group of physicians for input” “Two docs who are very knowledgeable handheld users and they have committed to being little pilot people for us” “A physician’s advisory group”	Involve selected physicians in implementation	
“Having a physician champion” “Individual doctors have sort of gone out and said, ‘Hey, you’ve got to see this.’” “If Dr. X talked to his partner or talked to his peer in surgery and told them that, then there would be a lot of credibility in that, not from me”	Leverage physician champions in promotion	
“The docs helped us sell it” “The biggest thing they are finding is once they start using it, they seem to really enjoy using it and start trying to find other things”	Consider introducing a killer application	Training and support
“One-on-one education, a manual that is user-friendly...and something that they could usually carry with them.... Also some online tutorials are good too” “Having somebody there available when we handed them out” “The most successful training was in person, one on one” “A customized education plan”	Flexible, user-friendly training	
“Once you get it and have had it for awhile, more questions come about.” “Give them the opportunity to have a refresher for that device in order to help increase its usage and also its potential and what it can do for that person.” “Checking back with them frequently, reviewing, seeing if they had any problems.”	Reintroduce, retrain	
“We have a help desk and they usually don’t call it. They call me.” “People right in their office can respond to their needs immediately.” “They preferred to call someone and ask the question.” “It’s very important that there is some baseline support for setting up when you first get involved. There’s troubleshooting for follow-up if you’re caught.”	Immediate, personal support	



respondents commented how "it just makes sense that they should make a difference."

### *Facilitation Theme 2: Promoting HHCs and Device Use*

A second theme around facilitating physicians' HHC use involved promotion. Promotion issues ranged from how to encourage HHC adoption to how to expand use among current owners. Several patterns emerged around getting physicians to initiate HHC use. A key pattern seen among the majority of our organizations was the use of pilot projects to experiment with HHC capabilities. Several organizations described purchasing HHCs for some physicians as part of these pilot projects.

Another pattern identified was the importance of involving selected physicians with the design, implementation, and promotion of HHCs. Organizations recommended that these physicians be included early in the process and emphasized involving "tech-conscious" physicians as part of the organization's HHC promotion strategy.

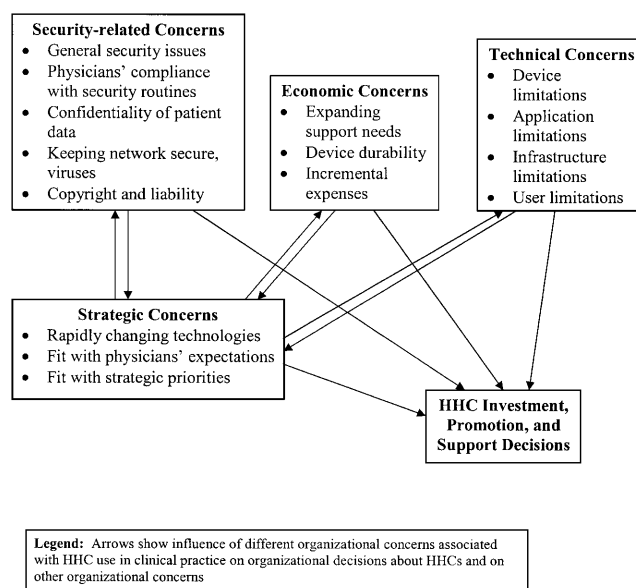
Finally, a key pattern within the promotion theme was the opportunity to expand HHC use by selecting and promoting an effective niche application rather than the device itself. "Niche users" have been defined as content to use a single application such as ePocrates (the pharmaceutical reference) or MedMath (a decision support application).<sup>2</sup> Organizations interested in expanding HHC use among physicians reported that the introduction of a "killer application" was very effective in demonstrating the value of HHCs.

### *Facilitation Theme 3: Providing Training and Support*

The importance of training and user support was a third theme that emerged from the data about facilitating physicians' HHC use. We found a dominant pattern across responses that stressed the need for training that accommodates physician preferences and needs and is provided in multiple formats and settings. A second pattern appeared from comments highlighting the importance of retraining. Organizations were reportedly able to expand HHC use among existing users by paying attention to these retraining needs and helping physicians use HHCs "to their full potential" and to "get the most out of the devices." A related pattern emerged around the need for real-time HHC support within organizations. Consensus among our study organizations suggested that HHC support needed to be available one on one. While support calls could be filtered through a help desk, physicians needed immediate and personal attention to their concerns. Reducing physicians' anxieties about the new technology by providing adequate support appeared to facilitate physician use and sustain organizational relationships with physicians.

### **Organizational Concerns About HHC Use**

We found four related themes, broadly classified as organizational concerns, that influenced the extent to which an organization invested in, promoted, and supported HHCs: (1) security-related concerns, (2) economic concerns, (3) technical concerns, and (4) strategic concerns. Each of these concerns had the potential to influence organizational decisions about HHCs. In addition, strategic concerns could influence the other organizational concerns, whether security-related, economic, or technical. A model depicting these relationships is presented in Figure 2, and Table 2 shows representative comments and patterns in the data associated with each concern theme.



**Figure 2.** Model depicting influence of organizational concerns on handheld computer investment, promotion, and support decisions.

### *Concern Theme 1: Security-related Concerns*

Organizational representatives were consistently concerned about HHC security. Patterns emerged around both general security and physicians' compliance with security routines. Information systems department informants commonly were concerned about the lack of security. Attempts to build in security measures were less than ideal, often because of the extra time that they entailed. Moreover, the majority of physicians appeared largely unconcerned about security. Another notable pattern emerged around the confidentiality of patient data, raised as an issue in every organization. Given challenges with encryption and with physicians inadvertently leaving their devices accessible to others, some organizational IT representatives were reportedly very reluctant to promote HHCs. Related patterns also appeared around network security, viruses, copyright compliance, and liability.

### *Concern Theme 2: Economic Concerns*

Cost was another theme of consistent concern found across organizations. One notable pattern within this theme was related to the cost of ongoing support services. Most organizations expressed considerable surprise about expanding HHC support requests, although none reported regretting the actual investment and support decision. Another pattern appeared around device durability, and breakage and loss were commonly mentioned. Every case study site had several HHC disaster stories to tell. A final pattern that emerged was the notion of how the decision to support HHC use was unexpectedly associated with an endless stream of unpredictable incremental expenses. While HHCs were commonly described as "relatively inexpensive, noncapital requests," HHC use and support required "little things that cost money here and there," including device upgrades, application license fees, and so forth. Across organizations, representatives reported concern that the HHC investment and support decision had the potential to "nickel and dime" them into a level of financial commitment that they had not anticipated.

**Table 2 ■ Organizational Concerns About Handheld Computer Use****Security-related concerns****General security**

- "There is no security on these things"
- "A big weakness"
- "A big problem"

**Physician compliance with security measures**

- "The process of reauthenticating takes like 20 seconds"
- "We could...force the encryption...but we would have a lot of complaints"
- "Most guys have it set up right now that you just turn it on and there it is."

**Confidentiality of patient data**

- "These certainly create some new challenges with HIPAA"

**Network and viruses**

- "We want to make sure that it [the HHC] is not going to corrupt anything or eat away too much bandwidth."

**Copyright and liability**

- "When we put information on these things, who is responsible for its accuracy?"

**Economic concerns****Expanding support services**

- "What we discovered is that there is an ongoing maintenance that is going to take some effort."
- "I think we underestimated the effort."

**Device durability**

- "They are dropped in toilets, they are lost, and they are smashed."

**Incremental expenses**

- "When something bad happens, it's kind of 1,000 fixes."

**Technical concerns****Device limitations**

- "The size of the screen"
- "The speed of the device"
- "Battery life"
- HHCs "just are not there right now"

**Application limitations**

- "There is no perfect software"

**Infrastructure limitations**

- "There aren't enough printers"
- "We're not yet wireless"

**User limitations**

- "Limitations with the ability of physicians to grasp the technology and successfully use it"
- "Just the functional computer literacy of some of our medical staff is a barrier"

**Strategic concerns****Rapidly changing technologies**

- "It is a big up-front investment, particularly when you look at how quickly things change."
- "How do you spend big dollars on something today that you know is going to be obsolete?"
- "The question is 'what will the doctor find most useful and when?'"

**Physicians' expectations**

- Expectations are "ahead of the technology"
- "Higher" than reasonable

**Strategic priorities**

- "Where does the PDA fit?"
- "Trying to find the balance"
- "The use of PDAs, if not used wisely, could be an added expense that doesn't produce a reciprocal benefit."

**Concern Theme 3: Technical Concerns**

The third theme of technical concerns was not startling and included patterns around device, application, and infrastructure limitations. For instance, physician users were reportedly frustrated because various applications "didn't play with everything else," and described the so-called "Frogger problem" of conflicting games and applications. User limitations emerged as a fourth pattern that we categorized as a technical concern. Across organizations, many informants reported surprise at the basic level of some physicians' technical abilities.

**Concern Theme 4: Strategic Concerns**

Associated with each of these other concerns was the fundamental theme of strategy. As represented in Figure 2, strategic concerns can influence an organization's HHC investment, promotion, and support decisions both directly, as strategic considerations, and indirectly, by influencing other organizational considerations. Reciprocally, the other three concerns can influence strategic considerations, as when infrastructure limitations restrict strategic priorities.

Three patterns in the data were aggregated to characterize the strategic concern theme. First, a clear pattern of responses emerged around organizations' need to make HHC investment and support decisions in the context of rapidly changing technologies. Organizations committed to finding IT solutions that were attractive to physicians reported frustration about being unable to predict the future of technology advances. While classified as a strategic concern, this pattern was also clearly related to economic, technical, and security-related concerns about HHC use.

A second pattern involved the potential mismatch between physicians' expectations and HHC capabilities. Problems were reported when physicians' expectations were "higher" or "ahead of the technology," raising problems for organizational representatives who were trying to help physicians in clinical practice as well as build strong relationships with those clinicians. We often heard fears of "backlash" and heard expressed frustration about how HHCs "just can't do everything yet." This pattern represented a notable strategic concern but could also influence technical and economic concerns. For example, when organizations described how expanding support needs limited their ability to be continuously available, this potentially threatened their strategic intent in deciding to support physicians' HHC use.

The third pattern was the relationship between HHC use and other organizational priorities. The sense of needing to figure out "where does the PDA fit?" was shared by four of our seven case study organizations. In contrast, the remaining three organizations were less conflicted about HHC support, having decided that they were "okay with right now it being a display device." As one summarized, "it was just, hey, here is another tool you guys can use to get access to your patient information." This pattern around organizations' strategic priorities was noticeably related to the other organizational concerns. For example, for those organizations trying to find an "enterprise strategy" for HHCs, security, economic, and technical concerns appeared to be associated with concern about those strategic, organization-level decisions. However, for organizations pursuing HHC support as more of a physician-relations strategy, security, economic, and technical concerns were

typically related to individual user level issues rather than affecting overall organizational strategy. Determining the strategic role for HHCs within the organization appeared linked to organizational decisions about HHC support strategies. Thus, understanding the organization's strategic priorities was critical in helping organizations to align resource allocation and support decisions.

## Discussion

### Organizational Support Strategies

Organizations will likely continue to select different strategies to support HHC use, regardless of the decisions they make about implementing other new clinical information systems. Across the organizations that we studied, technology executives differed in their views about the role of HHCs. While some saw HHCs as a mobile access point for emerging Web-based clinical data systems and computerized physician order entry (CPOE) systems, others were content to let physician use remain personal. Active support strategies responded to physicians' interests in and demand for HHC support and appeared related to organizational interest in facilitating physicians' HHC adoption and use in clinical practice. In contrast, basic support strategies were apparently associated with little organizational interest in expanding HHC use but were viewed as an appropriate accommodation for physicians' increasing interest in the devices.

### Facilitators to Promote Physicians' HHC Adoption and Use

The organizations that we studied reported that in working with physicians, encouraging HHC adoption and appropriate use required forethought as well as strategic decision making about investment and support. Similar to other technologies, HHC adoption was facilitated when physicians understood the potential of HHCs and worked with colleagues who demonstrated usability or promoted the device's usefulness.<sup>25-27</sup> We found clear indications that many physicians wanted help with all aspects of HHC adoption and use, despite descriptions of HHCs as "intuitive" and "easy to learn." In particular, physicians expressed interest in assistance with application installation, initial training, and responsive answers to questions that arose during clinical HHC use. The decision to bring a new technology to the clinical encounter represents a decided risk to a physician's productivity and potentially affects both clinical performance and professional image in the eyes of patients and colleagues. Like any other new technology, HHC adoption and use follows a learning curve, and support requirements vary over time. Organizations hoping to facilitate physicians' HHC use must remain sensitive to this variability and flexibly responsive to physicians' needs.

### Concerns Influencing Investment, Promotion, and Support Decisions

Organizations frequently mentioned how HHCs are a markedly different technology from others used in clinical practice. Most IT representatives described the technology as "relatively simple" and "relatively inexpensive," in contrast to other IT implementations such as CPOE and electronic medical record (EMR) systems.<sup>25,26,28</sup> However, despite this technical simplicity, organizations were reportedly surprised by expanding support needs for HHCs. While substantial investments in capital were unnecessary, HHC support required

constantly available personnel to provide both device and application support for physician users and sometimes required technical staff to learn a new operating system or programming language, as discussed by several organizations. Similar to other IT implementations, it was difficult to predict all the organizational and systems modifications required by the new technology. Yet since HHC use in all organizations was relatively unplanned, strategic concerns were noteworthy. These concerns suggest that it is strategically important to capture information about both organizational and physician knowledge, attitudes, and behaviors regarding HHC use prior to widespread efforts to facilitate use in clinical practice. Our sense was that the organizations that we studied were particularly wary about the potential problems that HHC proliferation could bring, including security violations and unanticipated support expenditures. Considering strategic issues early in the process of making decisions about how to support HHC use in clinical practice was recommended and could reportedly affect physicians' perceptions about both the devices and the capabilities of the organization's IT department.

### Limitations of This Study

While our large sample of respondents represents a variety of perspectives of American physicians, participation was voluntary and our participants were self-selected. In addition, it is likely that physicians who participated were more interested in HHCs than others who did not participate, although we were able to include nonusers and skeptics in both our interviews and focus groups. Further, while our results may be transferable, the limits of qualitative research make us unable to generalize from our study. Also important, we acknowledge that our findings are limited by the stage of physicians' and organizations' learning about HHC use in clinical practice when we met with them. Future research may use a longitudinal design to permit study of how perspectives, facilitators, and concerns change over time, and especially how these factors may be related to changes in technologies and user aptitude.

## Conclusion

Our case study organizations reported that the growth of HHC use in clinical practice has occurred largely without plans or extensive budgets, in distinct contrast to other IT being promoted by health care organizations. Yet organizations interested in capitalizing on opportunities provided by HHCs in clinical practice must recognize that supporting HHC use involves individualized attention to existing and potential physician users rather than standardized implementation efforts. Further, IT departments interested in promoting and supporting physicians' HHC use may need to take the lead to resolve issues related to resource allocation and strategy that may not be immediately apparent to either physician users or organizational leadership. Early consideration of the strategic opportunities and issues in the HHC support decision process will likely have important impacts on both implementation success and physician perspectives about the technology, the IT department, and the organization.

## References ■

1. Fischer S, Stewart TE, Mehta S, Wax R, Lapinsky SE. Handheld computing in medicine. *J Am Med Inform Assoc.* 2003;10:139-49.

2. McAlearney AS, Schweikhart SB, Medow MA. Doctors' experience with handheld computers in clinical practice: qualitative study. *BMJ*. 2004;328:1162-5.
3. Al-Ubaydli M. Handheld computers for doctors. West Sussex, England: John Wiley; 2003.
4. Ying A. Mobile physician order entry. *J Health Inform Manag Res*. 2003;17:58-63.
5. Schuerenberg B. Are PDAs the future of health care IT? *Health Data Manag*. 2003;11:43-6.
6. Embi P. Information at hand: using handheld computers in medicine. *Cleve Clin J Med*. 2001;68:840-9.
7. Rothschild J, Lee T, Bae T, Bates D. Clinician use of a palmtop drug reference guide. *J Am Med Inform Assoc*. 2002;9:223-9.
8. Tudiver F. The use of personal digital assistants for health care providers today and in the future. *South Med J*. 2003;96:947-8.
9. Tooley M, Mayo A. Handheld technologies in a clinical setting: state of the technology and resources. *AACN Clin Issues*. 2003;14:342-9.
10. Manhattan Research LLC. Data highlights: Physician PDA users. New York: Manhattan Research LLC; 2004.
11. Harris Interactive. Physicians' use of handheld personal computing devices increases from 15% in 1999 to 26% in 2001. *Health Care Newslett*. 2001;1:1-4.
12. Wright P, Bartram C, Rogers N, et al. Text entry on handheld computers by older users. *Ergonomics*. 2000;43:702-16.
13. Schneider S, Kostecke R, Tokazewski J. Buying your first PDA. *Fam Pract Manag*. 2001;8:50-1.
14. Wilderman I, Dobrousin A, Cameron S. Which handheld computer is better for doctors? Part 1: comparing models with Palm operating systems. *Can Fam Physician*. 2003;49:1507-8, 1510-1.
15. Yin R. Case study research: design and methods. Newbury Park, CA: Sage; 1984.
16. Morgan DL. Focus groups as qualitative research. Thousand Oaks, CA: Sage; 1996.
17. Miles M, Huberman A. Qualitative data analysis. Thousand Oaks, CA: Sage; 1994.
18. Maxwell J. Qualitative research design. Thousand Oaks, CA: Sage; 1996.
19. Crabtree F, Miller W. Doing Qualitative Research. Thousand Oaks, CA: Sage; 1999.
20. Glaser B, Strauss A. The discovery of grounded theory: strategies for qualitative research. New York: Aldine de Gruyter; 1967.
21. McCracken G. The long interview. Thousand Oaks, CA: Sage; 1988.
22. Constan M. Qualitative analysis as a public event: the documentation of category development procedures. *Am Educ Res J*. 1992;29:253-66.
23. Strauss A, Corbin J. Basics of qualitative research: techniques and procedures for developing grounded theory. Thousand Oaks, CA: Sage; 1998.
24. Scientific Software Development. Atlas.ti. In. 4.2 ed. Berlin: Scientific Software Development; 1998.
25. Poon EG, Blumenthal D, Jaggi T, Honour MM, Bates DW, Kaushal R. Overcoming barriers to adopting and implementing computerized physician order entry systems in U.S. hospitals. *Health Aff*. 2004;23:184-90.
26. Miller RH, Sim I. Physicians' use of electronic medical records: barriers and solutions. *Health Aff*. 2004;32:116-26.
27. Rogers EM. Diffusion of innovations. New York: Free Press; 1995.
28. Ash J, Gorman P, Lavelle M, Payne T, Massaro T, Frantz G, et al. A cross-site qualitative study of physician order entry. *J Am Med Inform Assoc*. 2003;10:188-200.